

# PHOTOSYNTHESIS and RESPIRATION

Chapters 8 and 9

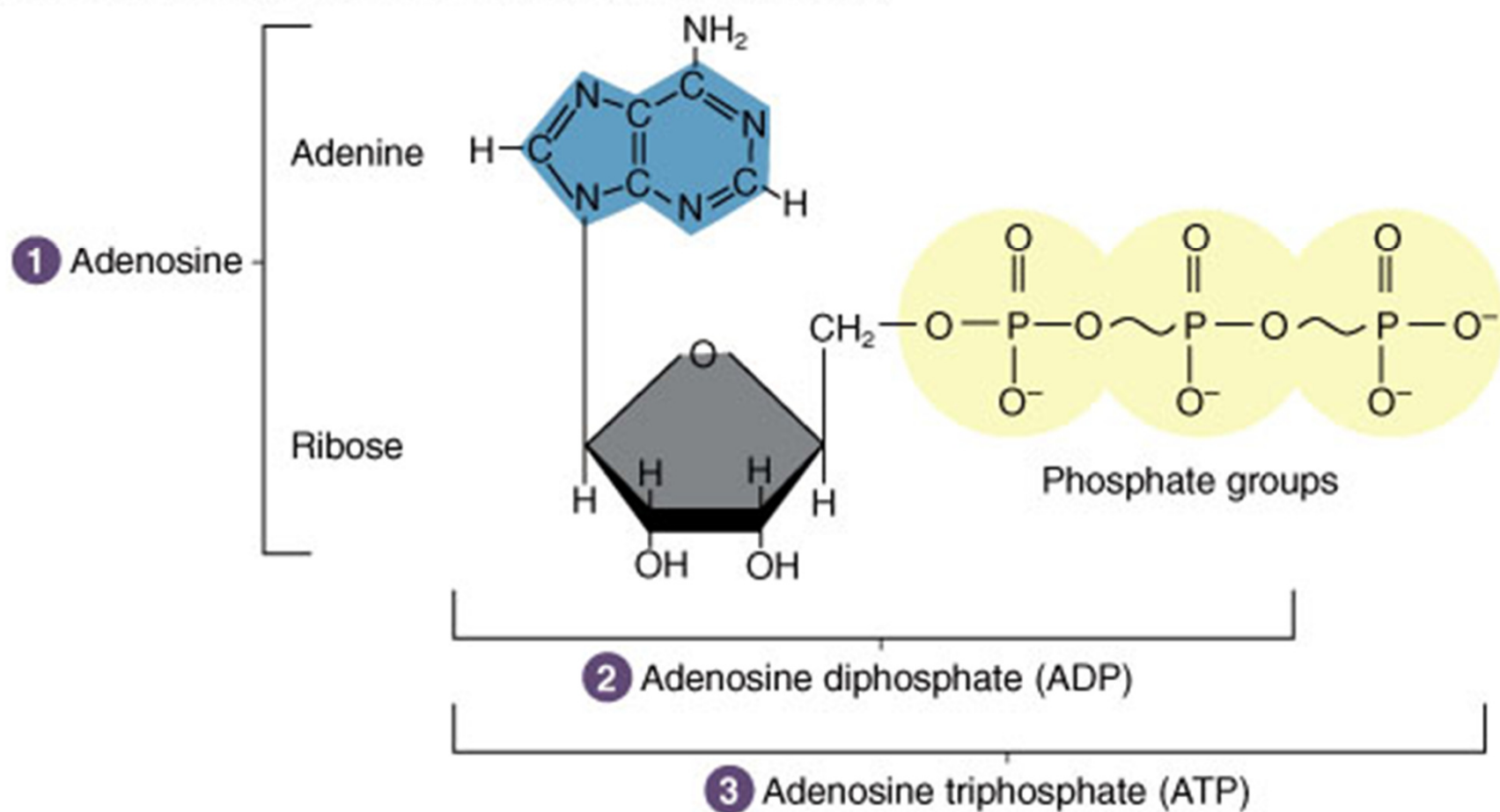
# Energy

- Many forms of energy
  - Light
  - Heat
  - Electrical
  - Chemical
- Living organisms use **ATP** to store and release energy



- Adenosine Triphosphate (ATP)
  - Stores and provides energy
  - Consists of
    - Adenosine
      - Ribose and Adenine
    - 3 phosphate groups
      - Energy is stored in bonds between phosphate groups
      - Energy is released when that bond is broken

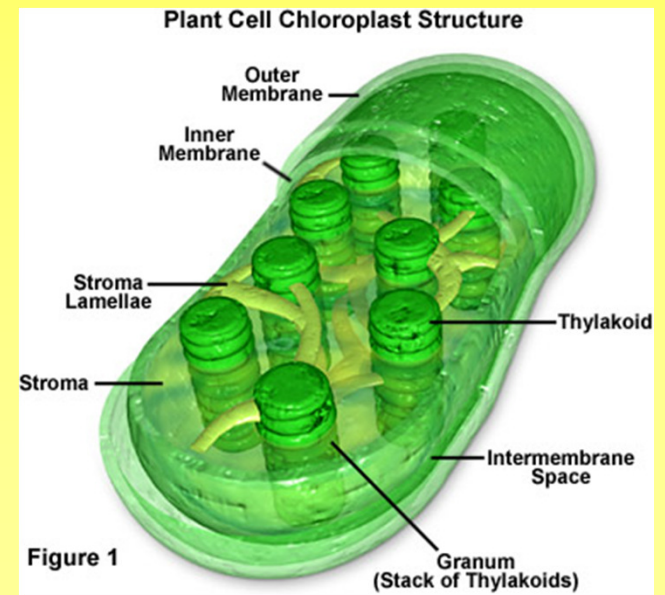
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- **Heterotrophs** =
  - Obtain food by consuming other organisms
  - Ex: Herbivores, carnivores, omnivores, detritivores
- **Autotrophs** =
  - Make their own food
  - Ex: Plants, algae, some bacteria
  - **Photosynthesis** =
    - Converts light energy to chemical energy
    - Reactants
      - Sunlight + Water + Carbon dioxide
    - Products
      - Sugars (Glucose) + Oxygen

# Photosynthesis Overview

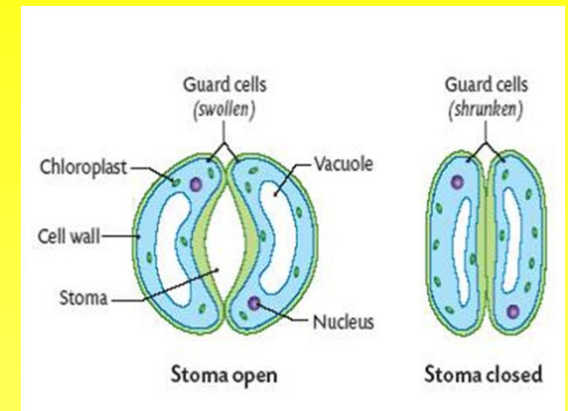
- **Chloroplasts** =
  - Organelle in plants where photosynthesis takes place
  - Contain **chlorophyll** =
    - Principle pigment of plants that absorbs light
      - Absorbs blue-violet and red light well
      - Reflects green light



- Light-Dependent Reactions
  - Uses light to produce ATP
  - Requires water
  - Produces oxygen gas as a byproduct
- Light-Independent Reactions
  - AKA: Calvin Cycle
  - ATP is used to produce sugars from carbon dioxide
  - No light needed directly

- Factors affecting photosynthesis

- Temperature
- Light intensity
- Water availability



- Adaptations to prevent water loss

- Waxy coatings on leaves
- Guard cells close openings in leaves (stoma)
- CAM plants close stoma during the day (when it is hotter)
  - Gas exchange occurs at night



# Cellular Respiration Overview

- **Cellular respiration** =
  - Releases energy from food in the presence of oxygen
    - Reactants
      - Oxygen + Glucose
    - Products
      - Carbon dioxide + Water + Energy (ATP)
  - Energy release is controlled by storing it in bonds of ATP
  - Primarily occurs in **mitochondria** =
    - Organelle that converts chemical energy stored in food to usable energy for the cell (ATP)

- Stages of Cellular Respiration

- 1. Glycolysis

- Glucose is broken down into pyruvic acid
    - Produces some ATP and electron carriers for last stage
    - Occurs in cytoplasm
    - Disadvantage
      - Only a small amount of ATP is produced
    - Advantages
      - Quickly produces ATP
      - Does NOT require oxygen (**anaerobic**)

## 2. Krebs Cycle

- Pyruvic acid is broken down into carbon dioxide
- Produces some ATP and electron carriers for next stage

## 3. Electron Transport Chain

- Large amounts of ATP produced
- Oxygen is essential

# Fermentation

- **Fermentation** =
  - The process by which cells release energy in the absence of oxygen
    - Anaerobic
      - Follow glycolysis if oxygen is not present
  - Occurs in cytoplasm

– **Alcoholic fermentation** =

- Produces ethyl alcohol and carbon dioxide
- Used by yeast and a few other microorganisms
  - Helpful in baking bread

– **Lactic acid fermentation** =

- Does NOT give off carbon dioxide
- Converts pyruvic acid to lactic acid
  - Helpful in production of cheese, yogurt, sour cream, pickles
- Used in muscle cells

# Photosynthesis vs Cellular Respiration

- Opposite processes
  - Both transform energy
    - Photosynthesis “deposits” energy in glucose
      - Converts light energy to chemical energy
    - Respiration “withdraws” energy from glucose
      - Converts chemical energy to ATP
  - Both exchange gases
    - Photosynthesis uses  $\text{CO}_2$  and releases  $\text{O}_2$
    - Respiration uses  $\text{O}_2$  and releases  $\text{CO}_2$

- Photosynthesis occurs in plants, algae, and some bacteria (but NOT animals)
  - Energy conversion occurs in chloroplasts
- Cellular respiration occurs in nearly all living organisms (including plants)
  - Energy conversion occurs primarily in mitochondria
  - Note: Some organisms use *fermentation* instead to produce energy in the absence of oxygen